Icarus

INTERNATIONAL JOURNAL OF SOLAR SYSTEM STUDIES

Volume 82 • 1989

EDITOR: *Joseph A. Burns*
ACTING EDITORS: *Peter J. Gierasch*
Joseph Veverka

Space Sciences Building
Cornell University
Ithaca, New York, 14853-6801

ACADEMIC PRESS, INC.
Harcourt Brace Jovanovich, Publishers
San Diego New York Boston
London Sydney Tokyo Toronto

Copyright © 1989 by Academic Press, Inc.

ALL RIGHTS RESERVED

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owner.

The appearance of the code at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per copy fee through the Copyright Clearance Center, Inc. (27 Congress Street, Salem, Massachusetts 01970), for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. Copy fees for pre-1989 articles are as shown on the article title pages; if no fee code appears on the title page, the copy fee is the same as for current articles.

0019-1035/89 $3.00

MADE IN THE UNITED STATES OF AMERICA

CONTENTS OF VOLUME 82

Number 1, November 1989

Damon P. Simonelli, James B. Pollack, Christopher P. McKay, Ray T. Reynolds, and Audrey L. Summers. The Carbon Budget in the Outer Solar Nebula 1

S. J. Peale. On the Density of Halley's Comet 36

K. Magee-Sauer, F. Scherb, F. L. Roesler, J. Harlander, and Barry L. Lutz. Fabry-Perot Observations of NH_2 Emission from Comet Halley..... 50

Wm. Hayden Smith and W. V. Schempp. [OI] in Comet Halley 61

A. Coustenis, B. Bézard, and D. Gautier. Titan's Atmosphere from Voyager Infrared Observations. II. The CH_3D Abundance and D/H Ratio from the 900–1200 cm^{-1} Spectral Region 67

N. Dubouloz, F. Raulin, E. Lellouch, and D. Gautier. Titan's Hypothesized Ocean Properties: The Influence of Surface Temperature and Atmospheric Composition Uncertainties 81

Fraser P. Fanale and James R. Salvail. The Water Regime of Asteroid (1) Ceres 97

Timothy J. Parker, R. Stephen Saunders, and Dale M. Schneeberger. Transitional Morphology in West Deuteronilus Mensae, Mars: Implications for Modification of the Lowland/Upland Boundary 111

Scott A. Sandford and John P. Bradley. Interplanetary Dust Particles Collected in the Stratosphere: Observations of Atmospheric Heating and Constraints on Their Interrelationships and Sources 146

J. S. B. McDonald, A. Hatzes, F. Bridges, and D. N. C. Lin. Mass Transfer during Ice Particle Collisions in Planetary Rings 167

Brian C. Flynn and Jeffrey N. Cuzzi. Regular Structure in the Inner Cassini Division of Saturn's Rings 180

A. Milani, A. M. Nobili, and M. Carpino. Dynamics of Pluto 200

Book Review

James R. Houck. *The Planetary System*. By David Morrison and Tobias Owen 218

Announcement..... 219

Number 2, December 1989

Acknowledgment

Joseph A. Burns. Acknowledgment of Referees: 1989 at *Icarus* and in Planetary Science 221

Regular Articles

Gregor E. Morfill and John A. Wood. Protoplanetary Accretion Disc Models: The Effects of Several Meteoritic, Astronomical, and Physical Constraints..... 225

Robert E. Grimm and Harry Y. McSween, Jr. Water and the Thermal Evolution of Carbonaceous Chondrite Parent Bodies..... 244

Pierre-Yves Longaretti. Uranian Ring Dynamics: An Analysis of Multimode Motions 281
Imke de Pater, Paul N. Romani, and Sushil K. Atreya. Uranus Deep Atmosphere Revealed 288
J. Hillier, P. Helfenstein, and J. Veverka. Miranda: Color and Albedo Variations from Voyager Photometry 314
Anne J. Verbiscer and Joseph Veverka. Albedo Dichotomy of Rhea: Hapke Analysis of Voyager Photometry 336
V. Zappalà, M. Di Martino, A. Cellino, P. Farinella, G. De Sanctis, and W. Ferreri. Rotational Properties of Outer Belt Asteroids 354
R. H. Giese and B. Kneißel. Three-Dimensional Models of the Zodiacal Dust Cloud. II. Compatibility of Proposed Infrared Models 369
D. K. Lynch, R. W. Russell, H. Campins, F. C. Witteborn, J. D. Bregman, D. M. Rank, and M. Cohen. 5- to 13-μm Airborne Observations of Comet Wilson 1986*l* 379
John J. Matese and Patrick G. Whitman. The Galactic Disk Tidal Field and the Nonrandom Distribution of Observed Oort Cloud Comets 389
Martin Duncan, Thomas Quinn, and Scott Tremaine. The Long-Term Evolution of Orbits in the Solar System: A Mapping Approach 402
Richard R. Zito. A New Mechanism for Lunar Transient Phenomena 419

Author Index for Volume 82 423

Cumulative Subject Index for Volumes 77–82 424

INFORMATION FOR AUTHORS

ICARUS is devoted to the publication of original contributions in the field of solar system studies. Manuscripts reporting the results of new research—observational, experimental, or theoretical—concerning the astronomy, geology, meteorology, physics, chemistry, biology, and other scientific aspects of our solar system or extrasolar systems are welcome. The journal generally does not publish papers devoted **exclusively** to the Sun, the Earth, celestial mechanics, meteorite studies or astrophysics. The preferred language of publication is English, but in special cases manuscripts are considered in French, German, or Russian. All papers are reviewed, generally by two independent referees. Authors are invited to submit a list of no more than five potential referees; the Editor may use this to guide his selection of referees. If authors so request in their cover letters, manuscripts will be handled anonymously during the refereeing process. Authors will usually be asked to respond to criticisms and suggestions by the referees prior to publication.

Manuscripts are accepted for review with the understanding that the same work has not been and will not be nor is presently submitted elsewhere, and that its submission for publication has been approved by all of the authors and by the institution where the work was carried out; further, that any person cited as a source of personal communications has approved such citation. Written authorization may be required at the Editor's discretion. For the benefit of the reviewers, three (3) copies of all crucial references cited in the manuscript as *submitted* or *in press* must accompany the paper. Articles and any other material published in ICARUS represent the opinions of the authors and should not be construed to reflect the opinions of the Editors or the Publisher.

Authors submitting a manuscript do so on the understanding that if it is accepted for publication, copyright in the article, including the right to reproduce the article in all forms and media, shall be assigned exclusively to the Publisher. The Publisher will not refuse any reasonable request by the author for permission to reproduce any of his or her contributions to the journal.

There are no page charges. However, authors will be charged for color reproduction or foldout pages; the publisher will provide an estimate of cost on request. Fifty **reprints** of each paper will be furnished gratis to the author and additional reprints may be purchased.

Manuscripts. *Four copies* of the manuscript, including figures, tables, etc., should be submitted to *Joseph A. Burns, Space Sciences Building, Cornell University, Ithaca, New York 14853-6801, telephone: 607-255-4875.* Authors should retain the original typescript. At least one set of figures should be suitable for camera-ready reproduction. All manuscripts must be typewritten with wide margins and *double-spaced throughout,* including references and footnotes. Number each page of the manuscript. Include on the first page the title of the paper and the name(s) and affiliation(s) of the author(s), including mailing address(es) and telephone number(s) [or telex number(s) or electronic mail address(es)]. At the bottom of the first page note the number of manuscript pages, figures, and tables. On the second page indicate a proposed running head of not more than 35 characters, and the name and address to which editorial correspondence and proofs should be directed. The third page should contain a brief abstract, and the text should begin on the following page. Following the main text, give Appendices, Acknowledgments, references, tables, figure captions, and figures, in that order. Places where figures and tables are to appear in the published paper should be marked in the margins of the manuscript.

Please write with attention to organization, style, and especially brevity. Present results logically, with order dictated by the needs of the reader. Take special care in composing the title and abstract, since these will be the most frequently read sections of the paper. In the title, specific words are preferable to general ones. The abstract should summarize the conclusions of the research, including quantitative results where appropriate, rather than merely stating the problem.

Whenever possible, quotients in mathematical expressions should employ the solidus (/) rather than being displayed in built-up form. However, for units, exponential notation is preferred (e.g., erg cm^{-2} sec^{-1}, not erg/cm^2 sec). Most authors will recall the difference between "i.e.," and "e.g.," will note that such nouns as "data" are plural and "mare" singular, and will take care to insert a zero before decimal fractions lying between +1 and −1.

Guidelines for Submission of "Notes": Papers on especially topical subjects will be given unusually rapid handling if they satisfy the following limitations on length:

(i) Manuscripts should be typed double-spaced and should be no longer than nine pages, including a very brief abstract of one or two sentences.

(ii) The sum of figures and tables should be less than, or equal to, two.

We expect that ICARUS will publish "Notes" within four months of submission, if no revision is required. We will try to complete refereeing and editorial handling in less than one month. In order to speed publication, proofs of "Notes" will be proofread only at Academic Press.

Tables are to be numbered consecutively with Roman numerals in order of their citation in the text. Each table should be typed, *double-spaced,* on a separate sheet with due regard to the proportions of the printed page. All tables should bear appropriate headings. Unusually elaborate tables should be prepared to allow them to be reproduced in the journal directly without typesetting.

Figures. At the time of submission of the manuscript, one original of each figure is to be submitted in such form as to permit photographic reproduction without redrawing. Line glossies should be carefully drafted, no larger than 22 × 30 cm. Original drawings, laser prints, or standard glossy photographic reproductions are acceptable. Authors should design figures so that they will fit one or two columns of print; in particular, the lettering should be large enough to allow a reduction to ⅓ the original size. *Each figure should be identified with the author's name and figure number.* All figures, whether line drawings or halftones, should be numbered consecutively in Arabic numerals, in order of their citation in the text. Figure captions should be typewritten on a separate sheet, following the text. Color plates and foldouts are published at the author's expense.

Literature citations in the text should be in one of the following forms: Encrenaz and Combes 1983 (for two authors); Safronov *et al.* 1986 (for three or more authors); Walker 1984, p. 198 (for reference to a specific page). To distinguish two or more works by the same author(s) in the same year, use suffixes a, b, etc., following the year (e.g., Öpik 1983a, 1983b).

Literature citations in the bibliography should be *listed alphabetically* according to the surname of the (first) author. Journal references should contain the *names and initials of all authors, the year, the title of the article, and standard abbreviation of the journal, the volume number, and the first and last page numbers.* Titles of journals and books should be in italics, volume numbers in boldface. (In a typed manuscript, indicate italics by single underlining and boldface by wavy underlining.) Below are shown examples of the proper reference forms for a book chapter, a journal article, and a book, respectively.

Borderies, N., P. Goldreich, and S. Tremaine 1984. Unsolved problems in planetary ring dynamics. In *Planetary Rings* (R. J. Greenberg and A. Brahic, Eds.), pp. 713–734. Univ. of Arizona Press, Tucson.

Jakosky, B. M., and P. R. Christensen 1986. Are the Viking Lander sites representative of the surface of Mars? *Icarus* **66,** 125–133.

Whipple, F. L. 1985. *The Mystery of Comets.* Random House, New York.

Careful compliance with these instructions for the preparation of the list of references is required; manuscripts with incomplete references (or missing abstracts) may be returned to the author for correction before being considered for publication.

Proofs will be sent to authors. When submitting a manuscript, the author should include a list of the symbols employed, identified typographically, not mathematically. This list will not be printed, but will help to avoid costly author's corrections in proof. Authors will be charged for excessive alterations in proof.